



## Principles and Rationale for Patellofemoral Inlay Arthroplasty

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Historically, patellofemoral arthroplasty (PFA) designs were derived from total knee prostheses thereby perpetuating the onlay concept for partial replacement into the patellofemoral joint. The introduction of artificial joint surface geometries into a sensitive biomechanical environment is counterproductive to restoring normal functional outcomes. Based on these principles, an off-the-shelf, patient specific patellofemoral inlay arthroplasty system was developed and introduced in 2008 (HemiCAP Wave, Arthrosurface, Inc, Franklin, MA) (Figure 1).

Malalignment of the extensor mechanism as well as overstuffing of the anterior compartment are frequent causes of anterior knee pain. Both can be symptomatic quite early and lead to high rates of early revision (1,2). This may also negatively impact postoperative range of motion and functional outcomes.

Intricate PF kinematics require a more defined arthroplasty approach than the historical replacement concept (Figure 2,3) (Table 1). A recent publication by Imhoff et al. outlined a sports medicine rationale for PF inlay arthroplasty following a structured decision algorithm that optimizes patient selection and outcomes (3) (Table 2).



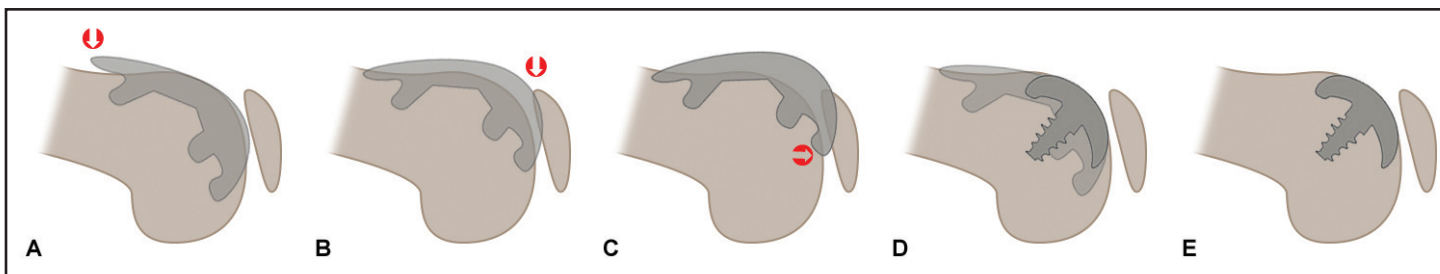
**Figure 1:** Patellofemoral HemiCAP Wave Inlay Arthroplasty. Screw fixation, trochlear component, and matching inlay patella implant.



**Figure 2A:** PF Inlay Arthroplasty with no Overstuffing




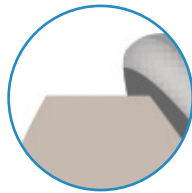
**Figure 2B:** PF Onlay Arthroplasty with Overstuffing



**Figure 3:** Comparison of Onlay vs. Inlay PF Arthroplasty

- A) Onlay: A flexed intramedullary guidance increases risk of proximal notching
- B) Onlay: Risk of anterior overstuffing
- C) Onlay: An extended intramedullary guidance increases risk of patella catching from flexion into extension
- D) Bone loss comparison of onlay (with risk of femur weakening – fracture) and inlay
- E) Inlay: Neutral implantation

**Table 1:** Design Characteristics of Inlay and Onlay Patellofemoral Prostheses. Modified from Lonner 2013 (4)\*

	Inlay	Onlay
		
Positioning*	Inset flush with native trochlea	Replaces entire trochlea, perpendicular to AP axis
Rotation*	Determined by native trochlea	Set by surgeon, perpendicular to AP axis
Width*	Narrower	Wider
Proximal Extension*	No further than native trochlear surface	Extends further proximal than native trochlea
Distal Extension	Ends 1mm above intercondylar notch	Extends into intercondylar notch
Shape	Lateralized	Symmetrical on the A/P axis
Anterior Fit	No notching of anterior cortex	May notch anterior femur
Implant Thickness	4mm thick	7-9mm
Joint Preservation	Better	Worse
Implantation Accuracy	Jig based milling with depth and axis control	Flat saw cuts and burring
Restoration of Native Geometry	Preservation of anatomic landmarks	Loss of anatomic landmarks
Risk of Overstuffing	None	Marked to Severe

In a recent matched pair comparison study by Feucht et al, using inlay and onlay trochlear designs for patellofemoral arthroplasty, the authors found no significant progression of tibiofemoral OA in the inlay group, whereas 53% of medial and/or lateral tibiofemoral joints showed OA progression in the onlay group (5).

Inlay patellofemoral arthroplasty offers inherent advantages by seamlessly matching the implant to the surrounding joint surface. The procedure can be effectively combined with balancing and corrective procedures that respect the patient's anatomy and the underlying pathology.

Pathology	Procedure
Isolated Grade III-IV PF arthrosis refractory to conservative and biological procedures	Isolated Inlay arthroplasty
PF arthrosis <b>plus</b> PF instability and trochlear dysplasia	Inlay arthroplasty <b>plus</b> MPFL reconstruction
PF arthrosis <b>plus</b> PF malalignment which is not controlled by creating a trochlea	Inlay arthroplasty <b>plus</b> osteotomy of the tibial tuberosity (medial/lateral, distal/proximal), Lateral retinacular lengthening

**Table 2:** Isolated Inlay Arthroplasty and Concomitant Procedures

## References:

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